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UNITED STATES NAVY

MEDICAL NEWS LETTER

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Policy

The U. S. Navy Medical News Letter is basically an official Medical Department publication inviting the attention of officers of the Medical Department of the Regular Navy and Naval Reserve to timely up-to-date items of official and professional interest relative to medicine, dentistry, and allied sciences. The amount of information used is only that necessary to inform adequately officers of the Medical Department of the existence and source of such information. The items used are neither intended to be, nor are they, susceptible to use by any officer as a substitute for any item or article in its original form. All readers of the News Letter are urged to obtain the original of those items of particular interest to the individual.

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Change of Address

Please forward changes of address for the News Letter to: Commanding Officer, U. S. Naval Medical School, National Naval Medical Center, Bethesda 14, Md., giving full name, rank, corps, and old and new addresses.

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The issuance of this publication approved by the Secretary of the Navy on 28 June 1961.

SPECIAL ARTICLE

Techniques for Motor Vehicle Drivers

This information has been compiled in cooperation with the National Safety Council, Traffic Safety Magazine, and Professor Amos E. Neyhart, author. (NavNews Editorial)

What would you do if your car went into a sudden skid? . . . If it ran off the roadway? . . . if a tire blew out?

Motorists are heading for the road in ever mounting numbers, increasing their chances of encountering unfamiliar driving conditions and running into emergency situations. Every driver should know what to do and should have practice in handling a vehicle under the different driving conditions. Emergency situations can usually be avoided if drivers use sound driving practices in the first place.

One can define sound driving practices as those used by drivers considering their own physical condition and limitations, condition of the roadway, weather, congestion, and any other factors that could get them into traffic difficulties. Some of these advanced driving practices and skills are ones that we don't use very often and some that we don't use very well:

Merging with Traffic on Freeways. Sound driving practice is to drive in the accelerating lane at a speed that will permit blending with the traffic on the freeway and not cause the freeway traffic to slow down or stop.

Passing a Slower Moving Vehicle. The good driver takes command of the passing situation before the actual pass is made. He does not get close to the vehicle he intends to pass. He stays back so that he can check traffic to the rear, to the side, and then ahead. If conditions are favorable for a pass, he signals his intentions to the driver ahead, and then makes a gradual smooth pass. When he sees the vehicle just passed in his rear view mirror, he then moves smoothly over to the right hand lane.

Let's take a look at the passing situation where the driver gets too close to the vehicle that he wishes to pass. In the first place, he has failed to take command of the passing situation. Just as he makes an abrupt turn to pass—the driver behind him may have the lane. Somebody has to yield or there is going to be a collision. In the second place, by getting close to the vehicle ahead, he has to make an abrupt turn to the left to clear the vehicle and then an abrupt turn to the right in order to return to the right lane.

Driving Around Curves. Traction requirements when driving at high speeds, especially on curves, are so much greater than at low speeds that few drivers realize the scant margin of safety against skidding generally existing at high speeds.

When a vehicle rounds a curve, centrifugal force tends to throw it outwards. It is a force which builds up rapidly with speed. For example, if the speed is doubled, centrifugal force will be four times as great. If power is applied as we round a curve, a portion of this power counteracts centrifugal force by setting up frictional resistance at the tires. If brakes are applied, we have a reverse direction to driving power, and have set up a force which aids centrifugal force to take the vehicle off the road. Thus, the risk of skidding off the road on a curve is seriously increased by applying brakes, but it may, within limits, be reduced by applying power.

Drivers should, therefore, form the habit of slowing down to a safe speed before turns, then round the curve with the foot on the accelerator, not on the brake.

Driving on Wet Roads. The tremendous increase in traffic in summer is presenting a new skidding problem and hazard. Thousands of cars and trucks speeding over major and super highways and parkways are depositing oily carbon at an estimated rate of 1000 gallons per mile per year.

It takes about a week to 10 days of dry weather to acquire a dangerous deposit of dirt, dust, and this oily film. Then a wet, foggy night or a first light sprinkle of rain supplies the necessary moisture to make this slick-covered highway actually as slippery as snow. This condition could involve the unsuspecting driver in a multiple car accident.

Driving Off Pavement Edge Onto Shoulder. The edge of the road pavement sometimes causes very serious accidents. A ridge between the road pavement and the road shoulder easily throws the car into a skid. It is important to keep all of the wheels of the car on the paved surface.

If the right wheels do get off the paved surface, there is a correct technique for getting them back on. Don't try to get back on the pavement at high speed. Avoid getting panicky. Never slam on the brakes. Drive straight ahead, with the right wheels off the pavement, and slow your car down gradually. Drive at a slow speed with the right wheels about two feet out on the shoulder, if possible. Check the roadway behind and then cut back on the pavement by turning the front wheels sharply to the left. If you jerk back at high speed, or attempt to get back while driving nearly parallel to the pavement edge, you can ruin tires, throw the car into a dangerous skid, or cause it to roll over.

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U.S. Navy Admission Rate Shows Decline. Viewed against the background of the last 10 years, the admission rate due to motor-vehicle accidents in 1960 gave cause for encouragement. For the fourth consecutive year there was a substantial reduction; the 1960 rate was the lowest of the 10-year period 1951-1960, and 24% below the peak rate of the decade (in 1956). This improvement is impressive when considered alongside the record for the entire population of the United States where the number of injuries mounted rapidly in 1960, increasing more than 7% over 1959. (Statistics, Navy Medicine, August 1961)

Motor Vehicle Accidents - 1960

Foreword. Year after year, our nation is faced with a deplorable loss of human resources through automobile accidents. While medical science is making great strides in conquering the death-causing diseases, the automobile accident defies all attempts toward its control. It strikes hardest at the young men who are at the very peak of youthful vigor. As a result, it takes an appalling toll among naval personnel. Year after year, it is the leading cause of death in the Navy and Marine Corps.

The 1960 statistics on motor-vehicle accidents among naval personnel yield some encouragement. While injuries mounted alarmingly in the population of the United States as a whole, they declined for the naval population. This is an achievement of which the Navy and Marine Corps may justly be proud. Regretfully, however, it is observed that this improvement did not extend to the death rate. This failure to reduce the number of deaths is of grave concern to every member of the service.

Knowledge of the 506 lives lost during 1960 surely is enough to impel all personnel to strive toward making safety on our highways a reality. All are urged to unite in this common purpose.

E. C. Kenney

E. C. KENNEY
Rear Admiral MC USN
Surgeon General of the Navy

The ever present motor-vehicle accident again far outpaced all other causes of death among Navy and Marine Corps personnel. In 1960, it caused 506 deaths—one-third of the total number of deaths occurring among all active-duty naval personnel during the year. In addition to this irrevocable loss, more than 5000 members of the Navy and Marine Corps, many maimed for life, were admitted to medical facilities for treatment of nonfatal injuries. Numerous approaches have been used in attempts to reduce the appalling human and economic losses resulting from automobile accidents. Highway safety programs, strict law enforcement, adjustment of leave schedules, and restrictions on use of automobiles are among the many measures employed in the Navy. Current statistics indicate that these efforts have met with a measurable degree of success.

Review of motor-vehicle accident admission rates from the peak of 1956 through 1960 shows a decline in all naval districts. The greatest reduction was observed

in the 3rd Naval District where the rate for 1960 was less than half the rate for 1956. The 8th and 13th Naval Districts showed the least change over this 5-year period. In 1960, these two districts had the highest rates of any of the naval districts.

In contrast to the admission rate, the death rate from motor-vehicle accidents among naval personnel showed no improvement in 1960—it increased almost one-half of 1%. Thus, the most sobering aspect of the motor-vehicle accidents among naval personnel in recent years is the fatality ratio. It has increased each year since 1954. There were 9 deaths out of every 100 admitted for injuries in 1960—an increase from 7 per 100 in 1954. Thus, more severe injuries are incurred than formerly.

Personnel admitted to the sicklist during 1960 as the result of motor-vehicle accidents averaged 43 days on the sicklist. This was a little longer than in 1959 when the average was 40 days. As a result of the longer stay, the noneffective rate (reflecting the average number of persons on the sicklist per day) increased slightly, in spite of the reduction in the admission rate. During the last 10 years, the average length of stay for motor-vehicle accident cases has shown no definite trend, but has fluctuated between a high of 46 sick days per case (in 1952) and a low of 40 sick days per case (in 1959).

Enlisted personnel are involved in motor-vehicle accidents much more frequently than officers—their admission and death rates in 1960 were more than three times the rates for officers. In addition, there was a noticeable difference within enlisted pay grades, particularly in admission rates. Personnel in the higher pay grades had fewer accidents requiring admission to the sicklist than those in the lower pay grades. The exception was pay grade E-1 where the restricted status of personnel in recruit training exerted a heavy influence.

Automobile accidents consistently take a greater toll among Marine Corps personnel than among those in the Navy. In 1960, the Marine Corps motor-vehicle accident admission rate was approximately 30% above the Navy rate. The difference between death rates was even more pronounced—the Marine Corps rate was 45% higher than the Navy's. In addition, the Navy's motor-vehicle accident record showed improvement over 1959, while the Marine Corps' did not.

Motor-vehicle accidents took their highest toll among fully indoctrinated and trained personnel with years of service ahead of them. Both admission and death rates were highest in age group 20-24 years. Similarly, personnel in service from 2 to 3 years had the highest rates of any length-of-service group.

Personnel on leave or liberty accounted for 88% of the admissions and 92% of the deaths. Most of the accidents involved occupants of passenger automobiles (three-fourths of the persons admitted), but motorcycles were also frequently involved. They accounted for 12% of the admissions.

The leading cause of motor-vehicle accidents was "running off roadway." "Collision with another vehicle' ranked second in frequency. Over one-half of the motor-vehicle accident admissions and deaths involved occupants of vehicles in these two types of accidents.

As would be expected, the fatality ratio varied by type of accident. However, there was little difference in fatality rates between occupants injured in collision with another motor vehicle and those injured in running off the roadway; approximately one out of every 10 such injuries was fatal. Survival was least frequent for occupants of vehicles colliding with trains; one out of about every 3 was a fatality.

As usual, most accidents occurred on weekends when travel was heaviest. Saturday was the worst day on the road for naval personnel in terms of deaths; Friday was the next most dangerous day; and Sunday ranked third. Also, the case-fatality rate was highest on Saturday—there were 12 deaths for every 100 admissions.

During calendar year 1960, motor vehicles caused more admissions and deaths during the summer and fall seasons than in the winter or spring. July led all months in the number of admissions, while October led in number of deaths.

In every week of the year but one, at least 5 lives of Navy or Marine Corps personnel were lost. The largest number of fatalities in any single week was 20. This occurred twice—the weeks including Memorial Day and the Fourth of July. In fact, on one day alone in each of these 2 weeks, 8 deaths occurred, Friday, May 27th, and Tuesday, July 5th. Thus, the holidays, with heavier travel and longer leave and liberty periods, contributed greatly to the automobile accident toll.

These statistics are presented to show the gravity of the motor-vehicle accident problem to the Navy and Marine Corps. Prevention of these accidents is of vital importance. They destroy lives; they take men away from their work; they increase the workload of medical facilities; and they cost hundreds of thousands of dollars. Every individual in the Navy and Marine Corps can make a positive contribution to military effectiveness by being safety conscious.

Statistics of Navy Medicine, August 1961

Restricted-Activity Days. An estimated total of 2.8 billion days of restricted activity was reported for the 12-month period ending June 1960. This total represents an average of 16 days of activity restriction during the year for each person in the civilian noninstitutional population of the United States. A day of restricted activity is defined as a day on which the person cut down on his usual activities for the whole of that day as a result of an illness or injury, or a bed-disability day if the person spent all or most of the day in bed due to illness or injury. (Health Statistics, PHS DHEW, July 1959 - June 1960)

Unsuspected Urinary Tract Infection in Pregnant and Toxemic Patients

F.A. Finnerty Jr, Asst Professor of Medicine and Pharmacology, Georgetown University School of Medicine; G.D. Massaro, Nikos Kakaviatos, and Victor Chupkovich, Research Fellows in Medicine, Georgetown University School of Medicine, Washington, D. C. New Engl J Med 265:534-537, 14 September 1961.

Previous studies from this clinic* have suggested that toxemia is a catchall diagnosis for a variety of syndromes characterized by elevation in arterial pressure, edema, and proteinuria. Whereas, these findings are consistent with toxemia they are not diagnostic, being observed also in pregnant patients with hypertensive vascular disease, pyelonephritis, glomerulonephritis, or any combination of these diseases. From the standpoint of long-term prognosis, it is obviously important to make an accurate diagnosis. From the practical point of view, however, it actually makes little difference whether hypertensive vascular disease, glomerulonephritis, or toxemia is present since the most important therapy in each of these diseases consists of sodium diuresis. The efficacy of the thiazides in lowering the arterial pressure and promoting diuresis has practically done away with the need for antihypertensive agents in these patients.

Such therapy, however, is of little value in pyelonephritis, in which early diagnosis and prompt treatment are most important. Many investigators have recently commented that pyelonephritis may occur in pregnant patients without genitourinary tract symptoms; experience in this clinic has suggested that the sole abnormality in pregnant patients with pyelonephritis may be proteinuria. It became apparent, therefore, that bacteriologic studies of the urine had to be performed in these patients if pyelonephritis was not to be overlooked. Preliminary studies have suggested that proteinuria in a pregnant patient more commonly indicates genitourinary tract infection than toxemia. Early recognition of genitourinary tract infection is particularly important in pregnancy, for it has been shown that its presence causes an increased incidence of fetal mortality and prematurity that can be prevented by adequate treatment of the mother. Therefore, it seemed important to extend preliminary observations to determine the actual incidence of genitourinary tract infection in pregnant patients with proteinuria and in normal pregnant patients. The results of this study are recorded here.

Bacteriologic studies were performed on 202 asymptomatic pregnant patients. One hundred and two (suspected of having toxemia) showed only proteinuria, whereas 100 patients were entirely normal. The urine of 25 (25%) of the 102 patients with proteinuria grew organisms usually considered pathogenic (Escherichia coli, proteus, and aerobacter), with colony counts greater than 100,000 bacteria per milliliter. There was a positive gram stain on the unspun urine in 24 of the 25 pregnant patients. The urine of 14 of the 100 normal pregnant patients showed organisms usually considered pathogenic for the urine with

colony counts of more than 100,000 bacteria per milliliter. A positive gram stain on the unspun urine was noted in all 14 of these patients.

These data suggest that if genitourinary tract infection is not to be overlooked, a urine culture and colony count (or gram stain on the unspun urine) must be performed on all pregnant patients with proteinuria and incorporated in the prenatal routine for all normal patients.

* From the Department of Medicine, Georgetown University School of Medicine, and the Georgetown Medical Division, and the Georgetown and George Washington Obstetrical Divisions of the District of Columbia General Hospital (This work was done during Dr. Finnerty's tenure of an established investigatorship of the American Heart Association). Supported by research grants from the American Heart Association;the National Heart Institute (H-2509 and H-4286); Charles Pfizer and Company, Inc., Brooklyn, N.Y; and Ciba Pharmaceuticals, Inc., Summit, N.J.

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Office Treatment of Pilonidal Sinus

J.A. Rickles, Miami, Fla. J Int Coll Surg 36: 71-76, July 1961.

Pilonidal sinus, frequently encountered in the military service, is discussed from the point of view of office treatment from which the author has obtained excellent results and the virtual elimination of recurrence over periods as long as 9 years. His technic which requires no hospitalization is described in detail.

The popular surgical procedure for the treatment of pilonidal sinus is based on the unproved theory that this disease has an embryonic origin—a theory so widely accepted that most current textbooks, in discussing pilonidal suppuration, state as a simple fact that the disease is congenital. Because of this acceptance of the congenital remnant theory, the doctrine of wide block excision has been taught to surgeons for many years as the one and only treatment of pilonidal disease. The use of wider and more extensive block removal has increased the number of days in the hospital and weeks of disability for these patients who are undergoing radical treatment for what is, in fact, a simple type of suppuration of the sinus tract. In recent years, many authors have written excellent articles concerning the treatment of this disease by marsupialization. This method, however, has not been widely accepted (Phelan, Hardaway, Zimmerman, Swinton and Markee, Marks, and Manning).

In 1955, Brearly wrote an excellent analysis of the origin of pilonidal sinus. Presenting his material in a logical and scientific way, he favored the theory that pilonidal disease is acquired. The author does not discuss the various theories of origin since these are available in other papers on the subject. It has not yet been demonstrated, however, that in the presence of pilonidal disease the hairs in the sinus tract grow from, or are even directly attached to, the cells that line the sinus tract. Usually, these hairs point in a distal

direction and inward. There have been many reports of the occurrence of hair cysts in other parts of the body, such as the hands, feet, and groin (Redding, Morrell, Oldfield, Palmer, Currie, Gibson and Goodall, Rueston, and Patey and Scarff). Such cysts have also occurred in other parts of the body, e.g., in a barber's hands, and are microscopically identical to the sacral coccygeal pilonidal cyst.

In addition to the purely microscopic and pathologic features of this disease which in no way imply a congenital origin, one must recognize the fact that its clinical features definitely substantiate the theory of its acquired origin. In almost all cases it occurs in male patients, the onset occurring between the ages of 15 and 30. It is rarely observed in patients under the age of 15 or as a primary condition in patients over the age of 30. Congenital diseases, on the other hand, show their highest incidence of symptoms in infants and children, a sharp decrease of these symptoms taking place by the time the patient reaches young adulthood. The body build is so significant that exceptions to these rules are extremely rare. Nearly every patient has a dark complexion, a marked growth of hair over the body, deep intergluteal folds, and a rather prominent postanal dimple.

Often trauma to the area is a factor that contributes to the development of the disease. An example of this was the jeep trauma associated with the tremendous number of pilonidal lesions observed in the Armed Forces during World War II.

In civilian practice, the disease is frequently observed in truck drivers and professional athletes. The fact that it is rare in women also supports the theory that body type is related to the development of the disease. An additional factor to be considered is that the use of toilet paper, with rubbing of the contaminated rectal discharge toward the postanal dimple and the hairy areas of the intergluteal folds, causes breaking off of the hair ends and packing of the sebaceous glands with infected fecal residue. Davage, in his personal communication with Dr. K. C. Samuel of India, noted that pilonidal sinus is uncommon in India where cleansing after defecation is accomplished by ablution and toilet paper is never used.

Klass has presented an excellent discussion of the pathogenesis of pilonidal disease. In a series of personal cases, 45 patients were treated conservatively and spent an absolute minimum of days in the hospital, losing practically no time from work.

The author began collecting the present group of statistics on pilonidal disease in 1950 after handling cases in which infected cysts were incised and abscess cavities drained, but in which there had been no definite reformation of the cystic canals. Treatment was given only to those patients who had infections that normally would have been subjected to a two-stage procedure—incision and drainage followed by secondary removal.

Office Treatment

The patient was placed face down on the operating table in the office. The entire operative area was thoroughly prepared by shaving and cleansing, just as would

be done in a hospital. A local anesthetic was infiltrated over the entire length of the cystic cavity, after which an incision was made into the cystic cavity, extending almost the entire length of the abscessed cavity. All foreign debris, including hairs, secretions, and pus, was gently removed, and the cavity was washed out thoroughly. A loosely placed iodoform gauze pack was left in the cavity to keep it open. The patient was then allowed to go about his business as usual, using warm compresses or sitz baths at home if he desired, although this was not absolutely necessary.

The patient would return to the office twice during the first week of the follow-up , at which time the packing would be removed and replaced. The cyst would have shrunk to approximately half its original size by the end of the week, and at this time, if there were no overhanging wound edges, the entire cystic cavity was cauterized with phenol. No anesthesia was required for this cautery. The phenol was allowed to remain in place for approximately one to two minutes, after which it was neutralized with alcohol. The phenol and cystic cavity were then washed out thoroughly with saline solution. The cavity was then loosely repacked; iodoform or furacin gauze was generally used for this purpose. The patient could then conduct himself as usual and could bathe, swim, or do whatever he desired. The packing was replaced approximately twice a week until the cavity became so small that packing was unnecessary. The wound filled by granulation, and by the time the granulations reached the surface the entire area was closed. The average time required for closure depended upon the size of the original cystic cavity between the second and third weeks. At no time during this treatment was any patient disabled. One patient, a professional golfer, continued to teach and play despite the presence of the drained and treated pilonidal tract.

After using this treatment for one year for patients with infections, the author adopted the same method for the treatment of uninfected patients, and at the time of writing, 122 patients have been handled in this manner. The sinus tract is always completely opened under local anesthesia; it is packed and left open for 2 or 3 days until the cyst has contracted so that no overhanging wound edges remain. When pilonidal cysts are present, the open tract may be cauterized without waiting the customary 2 to 3 days for the cyst to contract. Two percent Xylocaine has proved the most satisfactory local anesthetic. No anesthesia is required, however, for cauterization with phenol. The function of phenol is primarily to destroy the thick, scarred, granulomatous lining of the sinus cavity. Phenol is easy to apply and is usually painless. A clean granulating base will usually be observed within a few days after cauterization. The cavity will close as soon as the granulations reach the skin. In two patients, the wound required 3 months for closure rather than the usual 2 to 3 weeks, although there was no disability referable to the delayed healing.

It is important to emphasize the fact that these cysts are all induced by hairs; it is, therefore, necessary that patients be shaved two or three times weekly, especially if they have much body hair, until complete healing is obtained. Patients must be specifically instructed not to allow fecal matter to be drawn toward the opened surgical site after defecation.

In the present series, eight patients had undergone previous excisional therapy elsewhere on one or more occasions. All have responded well to the therapy here described. It must be pointed out, however, that a patient who had undergone wide excision and then has a recurrence of the disease has a large defect, and occasionally it may require several months for complete closure of this defect. This is undoubtedly due to the large amount of scar tissue accumulated in the area as a result of the previous operation and to the poor blood supply available in the granulating base. One patient in this series, despite having undergone four operations for a pilonidal condition, healed well with this method of treatment. It is necessary to stress once more the importance of shaving regularly around the wound, especially in those cases of recurrence in which the patient is treated by the open method here described. Follow-ups of these patients revealed that at each subsequent visit, several small pieces of broken hair were detectable in the draining wound. Once a good granulating base has been obtained, all that is necessary for a good result is that hair is not permitted to get into the granulating wound and that good personal hygiene with regard to bowel movement is maintained. Thus, all foreign material may be kept out of the wound until healing is complete.

Five patients in this series had to return for drainage of small intradermal abscesses. These healed after the skin was opened to the area containing the pus. None of the patients had a recurrent subcutaneous sinus tract.

Occasionally, a patient complains of pain in a healed wound in which there is no obvious abnormality. The author assumes that this pain is due to the same mechanism that causes painful scars after other types of surgical incision. No treatment has been given these patients, and none has shown any increase of disability that can be related to the pain in the incision which is self-limited. No true recurrence (development of a deep granulating sinus tract) has occurred.

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Control of Hemophilic Bleeding - Use of Autogenous Skin Grafts

J. E. McKittrick, formerly Resident in Surgery, Barnes Hospital, St. Louis, Mo. Present address: Santa Barbara Medical Clinic, 1421 State St., Santa Barbara, Calif. From the Department of Surgery, Washington University School of Medicine and Barnes Hospital, St. Louis, Mo. Ann Surg 154: 48-52, July 1961.

Attainment of hemostasis in even a trivial open wound in a severe hemophiliac may present extreme difficulty. Very few instances of the use of homologous or autogenous split thickness skin grafts in hemophiliacs have been recorded in the literature, and in only two instances were the grafts used to control hemorrhage. Davidson and Levenson, in 1945, were the first to use a split-thickness skin graft in a hemophilic patient. An autogenous graft was placed on

the right leg to cover a small epithelial defect healing very slowly by secondary intention. In 1954, Conway and Stark reported the use of a fresh homograft to control persistent bleeding from the right forearm after fasciotomy. Split thickness autogenous grafting was accomplished later without incident. In 1955, Fraenkel and Honey related their fascinating struggle to achieve hemostasis in a 22-year old man with an extensive but superficial gunshot wound of the left loin. Finally, with the simultaneous intravenous administration of concentrated animal antihemophilic globulin the oozing defect was covered with an autogenous split-thickness skin graft 5 weeks after injury. Bleeding from the loin was controlled and there was no bleeding from the donor site.

This paper reports two cases in which autogenous skin grafts were successfully used to control persistent or life-endangering hemorrhage in hemophilic patients, the third and fourth such cases reported in the literature.

There are two methods to secure hemostasis in a hemophiliac. These are direct pressure on the bleeding area and the administration of the missing factor in the blood, antihemophilic globulin, in the form of fresh frozen plasma or fresh whole blood. Meticulous surgical technic, always important, is mandatory in a hemophiliac. Devitalized tissue should be removed and every effort made to avoid infection. Infected wounds are always prone to secondary hemorrhage, and this is especially true in hemophiliacs.

The cases presented, as with the cases of Conway and of Fraenkel, are examples of a soft tissue defect with uncontrollable capillary oozing. Despite use of large amounts of fresh whole blood and hours of direct manual pressure in one case, the bleeding continued. The prospect of hemorrhage from the donor site has been a strong deterrent to the use of autogenous skin grafts in the hemophiliac, but this never materialized in the previously reported cases or in the author's cases. Avoiding areas of full-thickness loss in taking the grafts is desirable, or bleeding from the donor site might become a problem. In one case, two changes of the voluminous dressing on the left thigh donor site were necessitated in the first 24 hours by a remarkable extravasation of thin yellow fluid. There is no mention of this phenomenon by other authors. Despite this, the donor site healed uneventfully. Here again, the avoidance of infection is important.

Although the occasion when skin grafting can be used is infrequent, it now appears that this operation can be performed with relative safety. Because a later procedure is necessary, homografting, as used by Conway and Stark, and Suma and Martin, seems less desirable.

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The art of the practice of medicine is to be learned only by experience; 'tis not an inheritance; it cannot be revealed. Learn to see, learn to hear, learn to feel, learn to smell, and know that by practice alone can you become expert.

—Sir William Osler

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Tracheotomy - Its Complications and Their Management

J. W. Meade, Senior Asst Resident, Third (Boston University) Surgical Service and Research Laboratory, Boston City Hospital. New Engl J Med 265: 519-523, 14 September 1961.

There is little emphasis in medical or nursing instruction on the proper postoperative management of tracheotomy or the formidable complications that may attend it. This paper discusses these problems.

A study of 212 consecutive unselected tracheotomies performed by the House Staff of the Boston City Hospital (January 1957 through June 1959) is presented. The patients were primarily adults (only 13% being under 10 years of age, and most being in the seventh decade of life).

Indications for tracheotomy were: mechanical ventilatory obstruction due to tumor, infectious disease or trauma, 41%; secretional ventilatory obstruction due to the flooding of the alveoli with retained secretions from overwhelming pulmonary disease, respiratory burns, or the patient's inability to cough, 55%; and miscellaneous conditions in which the tracheotomy was done as an elective or mandatory procedure in surgery of the head or neck, 4%.

The over-all mortality of the series was 64%, but in only 2.8% could death be ascribed directly to the tracheotomy since in most cases it was due to the primary disease. Complications developed in 33%. Despite the warnings of Chevalier Jackson, little reference is made in the literature to the complications of tracheotomy. Four major series of operations have been reported from 1934 to 1961.

Comparison is difficult because complications have been included that cannot be considered peculiar to tracheotomies alone, or even as operative complications per se. Although some series report operative or technical problems as a complication, difficult procedures cannot be termed complications unless there is a gross surgical error present. Nelson includes deaths due to errors in judgment (that is, delay in operating) in the primary mortality. This not only is difficult to assess in a retrospective series, but also cannot be attributed directly to the operation. Significant complications not seen in this series were apnea, shock, tracheal and esophageal injury, persistent fistula, tracheal erosion, difficult extubation, and laryngotracheal stenosis.

Apnea, during or immediately after a tracheotomy, is usually indicative of irreversible anoxia due to the severity of respiratory obstruction. In cases with chronic asphyxia and respiratory acidosis, the sudden oxygenation of the lungs after operation may remove the stimulus to respiration. Such patients will have apnea without cyanosis. Treatment should be directed toward artificial respiration by intermittent positive pressure to avoid death from hypercapnia.

Shock may occur after tracheotomy in the absence of hypovolemia or other postoperative physiologic derangements. It too is probably related to biochemical alterations secondary to carbon dioxide retention. Although the

exact mechanism is not clear, sudden reversal of respiratory acidosis may result in cardiovascular collapse.

Tracheal and esophageal injuries generally occur in children. Their tracheas collapse easily and, on coughing, as the posterior wall of the trachea bulges forward into the lumen, the knife may penetrate both the posterior wall of the trachea and the esophagus. To avoid a fistula the defect must be repaired at once.

Tracheal erosion may cause late hemorrhage and mediastinitis. This is often seen in children since it is difficult to find a cannula having both a short stem and an adequate diameter. Winter and Gilmore have devised a modified cannula to avoid this problem.

Difficult extubation is usually seen in children because they often become accustomed to breathing through a tracheostoma and are unwilling to tolerate decannulation. The best method of treatment is gradual occlusion of the cannula with the use of corks of progressively increasing size made of either plastic or hard rubber which, unlike commercial cork, will not fragment and be aspirated.

Jackson and Jackson state that 85% of the cases of laryngotracheal stenosis (now rare owing to discarding the technic of high tracheotomy or cricoidotomy) are due to the division of the cricoid cartilage. If division accidentally occurs, another incision should be made lower in the trachea for placement of the cannula. In case of stenosis the trachea may be gradually dilated.

In the author's series, the operative complications were emphysema (subcutaneous and mediastinal), pneumothorax and low incision; the postoperative were pulmonary difficulty (atelectasis, pneumonia, and lung abscess), endotracheitis, cannula difficulties, carbon dioxide retention, wound sepsis, stenosis, and keloid formation.

Six deaths in this series could be ascribed directly to complications resulting from the tracheotomy. Three were due to accidental dislodgment of the cannula with resultant ventilatory obstruction and asphyxia, two to postoperative pneumonia, and one to a misplaced operative incision.

These complications were preventable and could have been avoided by careful operative technic and by meticulous attention to correct postoperative management.

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Unusual Outbreak - New York State

An unusual outbreak of disease occurred from June 8 to 21 in New York State. It came to light when two physicians in a small community in Chenango County saw a large number of patients with signs and symptoms of appendicitis. Six appendectomies were performed. On operation, the patients were found to have mesenteric adenitis instead of appendicitis.

An attempt was made to determine the incidence of illness in the village and its environs (total population of 4600). The local industries had no unusual absenteeism. A visit by public health nurses to the homes of children absent

from the Central School (enrollment 1521) revealed 110 cases of illness ranging from mild cramp-like abdominal pain to more serious illness, lasting 5 to 6 days with pain and tenderness, especially in the RLQ and LLQ of the abdomen. Twenty-four had mild diarrhea. None had blood in the stool. In the cases seen by physicians, the temperatures ranged from 99 to 103 F. A few cases had abdominal muscle spasm. Other symptoms were: headache, nausea, dizziness, vomiting, and stiff neck. No respiratory complaints or pain in the chest were noted. Investigation revealed no common source.

The disturbing feature of the outbreak was the difficulty in distinguishing between real appendicitis which required surgery and the epidemic disease which did not.

Examination of stools from six cases and of tissue from an ileocecal lymph node yielded no virus on tissue culture or on mouse inoculation. Other laboratory findings were unrevealing. (Reported by D. P. McMahon, District Health Officer, Binghamton District, New York State Dept of Health: Morbidity and Mortality Weekly Rept, Comm Dis Center, PHS DHEW, Atlanta 22, Ga., September 15, 1961)

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MISCELLANY

Diabetes Mellitus Detection

A screening program discovered 1200 previously unknown cases of diabetes mellitus and reidentified 830 previously known cases among 196,000 persons tested in community programs in nineteen States and two U.S. Territories during fiscal year 1959, the Public Health Service has announced.

Results of these screening activities are reported in a recent issue of Public Health Reports by Dr. Glen W. McDonald, Quentin R. Remein, and Edward J. Durdick of the Service's Division of Chronic Diseases.

Over 4500 persons with positive tests were referred to their physicians for diagnostic confirmation. Nearly all of the persons screened were given blood sugar tests which are more accurate than urine tests in detecting diabetes. Only 385 of the total number of persons tested were screened in programs that used urine specimen tests exclusively.

Because of variations in populations tested and in testing technics, case yields in reported programs differed widely. Comparison of the over-all yield of 6.9 previously unknown cases per 1000 persons screened with national prevalence estimates of 8.0 cases per 1000 population suggests a need for increased casefinding efforts, the authors stated.

As means of attaining higher over-all yields in future programs, the authors advocate emphasis on blood sugar testing, more intensive follow-up of detected cases, and screening of high prevalence groups. Such groups include persons over 40 years old, relatives of diabetics, the obese, and parents of babies that weighed over 9 pounds at birth.

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Society Affiliations

The following honors have been received by Medical officers of the U. S. Navy:

CAPT Felix P. Ballenger MC USN, and
CAPT George M. Davis Jr. MC USN - Fellowship in American College of Chest Physicians
CAPT Arthur J. Draper - Fellowship in American College of Physicians
CAPT Joseph J. Timmes - Membership in American Association for Thoracic Surgery
CDR Jaime M. Benavides Jr - Fellowship in American College of Surgeons
CDR William M. Strunk - Membership in American College of Radiology
LCDR William J. Jacoby Jr - Associate of American College of Physicians

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American Board Certifications

American Board of Obstetrics and Gynecology
CAPT Ralph K. Brooks MC USN
CAPT S. P. Santiago-Stevenson MC USN

American Board of Pathology
LCDR Pasquale R. Ruffolo MC USNR

American Board of Pediatrics
LT John H. Mazur MC USN
LT Myron J. Winick MC USNR

American Board of Psychiatry and Neurology in Psychiatry
CDR Thomas H. Lewis MC USN

American Board of Radiology in Nuclear Medicine
LT John A. Gehweiler Jr MC USN

American Board of Surgery
LCDR Norman V. Cooley Jr MC USN
LCDR Milton E. Henderson MC USN

American Board of Surgery (continued)

LT Richard W. Hibner MC USNR
CDR Duncan O. Montgomery MC USN

American Board of Thoracic Surgery

CDR Robert P. Dobbie Jr MC USN
LCDR Don F. Thomas MC USN

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SECNAV INSTRUCTION 6100.1

14 August 1961

Subj: Physical Fitness Program

Ref: (a) DOD Memorandum of 18 Jul 1961, Subj: Physical Fitness Program (NOTAL)
(b) Manual of the Medical Department, chapter 15, article 8, para. (1)

Purpose. To set forth the policies and general guidance for physical fitness within the U.S. Naval Establishment.

Background. All personnel of the naval service must be in a state of physical fitness to be prepared immediately to perform duties for periods requiring long endurance under the most trying conditions. Time, conditions, and missions require that each individual not only maintain an acceptable state of physical readiness, but that each one's personal appearance reflects credit to our service and nation. Reference (a), memorandum from the Secretary of Defense to the Secretaries of the Army, Navy, and Air Force, has established the minimum physical fitness standards for the Department of Defense. It also directed that each service institute a program of physical fitness that will insure compliance with these standards.

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BUMED INSTRUCTION 5100.3

10 August 1961

Subj: Storage of flammable liquids in domestic type refrigerators; hazards of

Ref: (a) NAVMED P-5040, Code for Use of Flammable Anesthetics, June 1959 (see BUMED INST 5100.1B)

Purpose. To bring attention to the fire and explosive hazards presented by the storage of flammable liquids in domestic type refrigerators, and to recommend the proper precautionary measures that must be taken.

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<u>BUMED INSTRUCTION 6000.3</u> 30 August 1961

Subj: Reporting births and deaths in cooperation with other agencies

Encl: (1) SECNAV Instruction 6000.5

<u>Purpose</u>. This instruction promulgates information about reporting births and deaths, including births to which Enclosure (1) is applicable.

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<u>BUPERS INSTRUCTION 1306.72</u> 21 August 1961

Subj: Assignment of certain enlisted patients to medical holding companies established at naval activities

<u>Purpose</u>. This instruction authorizes the establishment of medical holding companies at naval activities and the assignment of certain types of patients to such units for temporary additional duty.

(NOTE: This instruction contains two paragraphs on background factors and specific actions required for its implementation.)

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IN MEMORIAM

RADM Joseph J. McMullin MC USN (Ret)	24 August 1961
CAPT Charles W. Lane MC USN (Ret)	15 July 1961
CAPT Charles G. MacCormack MC USN (Ret)	18 September 1961
CAPT Russel F. Sanders MC USN	1 September 1961
CDR John E. Herlihy DC USN (Ret)	10 August 1961
CDR Eustice H. Prescott MC USN (Ret)	8 September 1961
CDR Bernard W. Rothblatt MC USN (Ret)	27 June 1961
LCDR Edward F. Aron MSC USN (Ret)	2 July 1961
LCDR Ralph C. Boren MC USN (Ret)	23 August 1961
LCDR Harry F. Everroad MSC USN (Ret)	12 July 1961
LCDR Albert B. Montgomery MSC USN (Ret)	7 August 1961
LCDR Charles E. Smith MSC USN (Ret)	16 August 1961
LT George L. Crain MSC USN (Ret)	22 June 1961
LT Mathias F. Forst HC USN (Ret)	4 August 1961
LT Reed W. James MSC USN (Ret)	19 August 1961
LT John B. Smith MSC USN (Ret)	25 September 1961
CMSW-3 Thomas E. Harper USN	21 August 1961

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From the Note Book

New Executive Director, Assn Mil Surg. The Executive Council of the Association of Military Surgeons of the United States announces the appointment of Major General Thomas J. Hartford, Deputy Surgeon General of the Army, to the position of Executive Director of the Association, effective 15 October 1961. He retired on September 30 with more than 30 years of military service. Announcing the appointment, Dr. Leroy E. Burney, President of the Association, said: "General Hartford brings to our Association his long years of experience in administration and military medical matters. He will give his full attention to the administration of the Association which will permit Colonel Robert E. Bitner to devote more time to expanding the services and influence of the Association as Editor of Military Medicine, our official journal."

The Association of Military Surgeons of the United States was organized in 1891 and incorporated by an Act of Congress in 1903. Its membership, numbering more than 6000, is open to active and inactive commissioned officers of the Federal Medical Services, civil members of the medical staffs of the Army, Navy, Air Force, U.S. Public Health Service, and the Veterans Administration; also officers of military medical services of some foreign countries.

Announcement. The 68th Annual Meeting of the Association of Military Surgeons will be held in Washington, D. C. at the Mayflower Hotel, 6, 7, and 8 November 1961. Copies of the scientific program and listed events have been given wide distribution. As is the convention's collateral tradition, wives and guests of Association members, as well as other ladies, will be entertained at a luncheon featuring fine food, Japanese dancing, music, a fashion show, and attractive prizes and favors. This year's planning and hostessing are provided by the wives of the Ladies' Wing of the Association with Mrs. James V. Lowry as Chairman. Headquarters of the group is at the Mayflower Hotel. Reservations, up to nine to a table, may be made by sending your name and remitting $3.75 per ticket to Mrs. Langdon C. Newman, 2706 South Hayes St., Arlington, Va., (Telephone: OTis 4-6868). Tours scheduled are:

Monday, 6 Nov	1:00 p.m.	Islamic Center and U.S. Naval Observatory
	4:00 to 5:00 p.m.	Mexican Embassy Tea ($1.50)
Tuesday, 7 Nov	12:00	Luncheon, Cotillion Room, Sheraton Park Hotel (Each ticket $3.75)
Wednesday, 8 Nov		Tour of Mount Vernon - Bus leaves at 9:00 a.m. Luncheon at Old Club in Alexandria ($4.00)
	Afternoon	Tour of National Institutes of Health. Bus leaves at 1:30 p.m. ($1.50)

Diphtheria in the U. S. - Present Trends. The occurrence of diphtheria in the United States during the present year is closely following the patterns observed regularly in past years. Although the total of 401 cases reported to date during 1961 has declined slightly when compared with previous years, this decrease is not great.

The concentration of diphtheria in the southern states continues to be striking. Of 401 reported cases, 311 (77.6%) have occurred in the 17 states comprising the South Atlantic, East South Central, and West South Central Divisions of the country. The sole consistent exception to the low level of diphtheria case incidence in the other states is Minnesota where during the past several years diphtheria associated with infection by a gravis strain C. diphtheriae has been repeatedly observed. A total of 24 cases has occurred in Minnesota so far this year. The coming of autumn in past years has regularly been accompanied by a striking increase in the occurrence of diphtheria. It is expected that this seasonal pattern will be following during 1961 to the same striking degree, although the rise in cases has not yet been reflected in the weekly state morbidity reports. (Morbidity and Mortality, PHS DHEW, Atlanta 22, Ga., Sept 29,1961)

Fat Infusions. Development of the overloading syndrome limits the usefulness of intravenous fat emulsions. The syndrome is characterized by sudden onset of high fever, rigor, headache, sorethroat or tender neck muscles, anorexia, and malaise, with onset usually following administration of the fat for longer than 2 weeks. The symptoms are accompanied by an anemia which is probably primarily due to hemolysis, but is accompanied by bone marrow depression in association with excessive fat deposition. From the practical point of view, administration of intravenous fat instead of glucose for short periods is of dubious benefit; its prolonged use is dangerous. Because the subtle toxic effects related to reticuloendothelial blockade and cell membrane operations have not been clarified, it seems wise to avoid noninvestigational use. (C. Alexander and L. Zieve, Arch Int Med, April 1961)

Viral Diseases: Their Control by Immunologic Means. It has long been held that a killed-virus antigen would not induce complete immunity, that the effect would be transient, and that many injections would be required. These preconceptions are false. An adequate antigenic stimulus with killed-virus poliomyelitis vaccine will induce long-lasting and possibly permanent effects. It is also possible that durable immunity can be induced by a single antigenic stimulus if it is sufficiently potent.

Exciting possibilities for the future include the addition to the poliomyelitis vaccines of other viruses that may behave in the same manner, to permit induction of immunity to many diseases at the same time. Very little new knowledge is required for this to be possible, and technics for acquiring the knowledge are at hand. (Jonas E. Salk, University of Pittsburgh School of Medicine, Pittsburgh, Pa. Postgrad Med 30: 99-110, August 1961)

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RESERVE SECTION

Promotion of Inactive Duty Officers

In the period of January-June each year, selection boards, composed of experienced senior officers, are appointed by the Secretary of the Navy to consider Reserve officers on inactive duty for promotion. Selection for promotion is a highly competitive process, in which all eligible personnel are evaluated on the basis of their past demonstrated performance, as recorded by their reporting seniors, and are further evaluated on their relative qualifications to serve in the next higher grade. The promotion cycle may be divided into four major categories; eligibility, selection, qualification, and appointment.

Eligibility

Promotion zones are established after a comprehensive study of the grade structure in the naval service has been completed. The purpose of the study is to assure equitable promotion opportunities among succeeding groups of Reserve officers within the authorized grade limitations established by law. The number of vacancies determined by the Secretary of the Navy to exist is predicated on a per centum of the total number of officers being considered for the first time (New Field). Thus, officers who have been considered one or more times (Old Field) vie with those being considered for the first time for these vacancies.

Official announcement of the promotion zones and of the convening dates of the selection boards is made by annual Bureau of Naval Personnel notices and also by publications such as Naval Reserve Association News, The Naval Reservist, All Hands, and Navy Times. If an officer's date of rank and register number place him within the promotion zone, he must meet other requirements to establish his eligibility for consideration by the appropriate selection board. These additional requirements are:

1. He must be in an active status, i. e., USNR-R or USNR-S1.
2. Prior to the beginning of the fiscal year in which the individual concerned will be in the established promotion zone or otherwise eligible for consideration for promotion, he shall earn an average of 12 promotion points for each year in grade computed from 1 July following date of rank, or from date of rank if it be 1 July, to 30 June of the fiscal year preceding the fiscal year in which he is in the established promotion zone. In no case shall more than 72 promotion points be required. (NOTE: This was effective 1 July 1961). Example: A lieutenant with a date of rank of 1 March 1956, in order to be

considered for selection for promotion by a selection board convening in April 1962, must have earned 60 promotion points.

Eligibility for consideration is established and determined as of the end of the fiscal year preceding the fiscal year in which the officer is considered for promotion. The records of those officers who have met requirements for consideration will be submitted to the proper selection board for consideration.

Selection

The selection process is performed by a group of officers who are ordered to the Bureau of Naval Personnel specifically for duty as members of a selection board and who are directed by the Secretary of the Navy to perform their duties in accordance with regulations for promotion of Naval Reserve officers as set forth in Title 10, U. S. Code, as follows:

"From among those officers who are eligible for consideration for promotion, each selection board shall recommend for promotion those officers whom it considers best fitted, or qualified for promotion."

Title 10 specifies that at least 50% of the selection board members shall, if practicable, be Reserve officers and that all members shall be senior in permanent grade and temporary rank to any officer being considered by that board. No officer shall serve on two consecutive selection boards when the second of such boards considers any of the officers who were considered but not recommended for promotion to the same grade by the first selection board upon which he served. Selection boards will be composed of at least 5 members, each of whom swears or affirms that he will, without prejudice or partiality and having in view both the special fitness of officers and the efficiency of the Navy, perform the duties imposed on him as a member of such board. In arriving at a decision relative to each individual eligible officer's promotional potential, the selection board considers the information contained in the fitness report jacket, the selection board jacket, any record of legal proceedings in cases where eligible officers are concerned, and health records of individual eligible officers. Since the proceedings of the various selection boards are conducted in strict confidence, no information is available as to why certain officers are recommended for promotion and others fail to be recommended. In general, failure of selection may be attributed to the fact that, within the numerical limitations as established by the Secretary of the Navy, an officer's record did not compare favorably enough with those of his contemporaries to permit his selection. Missing records do not automatically disqualify candidates from consideration; for if an officer has established his eligibility, his record will be submitted to the appropriate selection board for consideration, regardless of its condition.

Not less than a majority of the total membership of any selection board must concur in each recommendation made by the board.

By direction of the Secretary of the Navy, the selection board, during its deliberations, acts as an examining board, passing on the professional

qualifications of all recommended candidates and on their ability to meet further requirements.

Before it is published, a selection board report must be routed to cognizant offices in the Bureau of Naval Personnel, the Judge Advocate General, the Secretary of the Navy, the Secretary of Defense, and finally to the President for his signature of approval.

Qualification

After a report of the selection board is approved by the President of the United States, the Chief of Naval Personnel forwards a letter of notification to each selectee. This letter is sent to the selectee via the Reserve Officers Recording Activity, Omaha, Nebraska, which, by endorsement, indicates the promotion point status of the selectee and via the commandant or command holding the selectee's service record. This letter provides instructions concerning methods of establishing professional qualification, physical examination, and procedure for requesting appointment following qualification, and should be carefully read by the recipient.

Prior to 1 July 1961, a selectee had two complete fiscal years following the year in which selected to qualify professionally and physically. Effective 1 July 1961 the regulations were changed to provide for only one fiscal year in which to qualify.

To establish professional fitness for promotion, a number of promotion points must be earned in grade, computed as follows:

1. For promotion to lieutenant (junior grade), 12 promotion points for each 6 months in the grade of ensign, computed from date of rank to date of rank to be assigned as lieutenant (junior grade).
2. For promotion to lieutenant, lieutenant commander, or commander, 24 promotion points for each year in grade, computed from the 1st day of July following date of rank (or from date of rank, if it be 1 July) to 30 June of the fiscal year in which selected for promotion, but not to exceed a total of 144 promotion points.
3. For promotion to captain, officers will be given the option of qualifying by earning either an average of 24 points for each year in grade of commander, up to a maximum of 144 points, or by completing, in the grade of commander, one of the 6 courses of study as outlined in BuPers Instruction 1416.4C.

Promotion points earned in present grade only are creditable for promotion to the next higher grade.

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Captain Paul R. Leberman MC USNR

CAPT Paul R. Leberman MC USNR was elected Chairman, Section on Military Medicine of the Council on Scientific Assembly of the American Medical

Association at the annual convention of that body.

CAPT Leberman is Associate Professor of Clinical Urology, University of Pennsylvania School of Medicine and is Reserve Consultant to the Commanding Officer, U. S. Naval Hospital, Philadelphia, Pa. His home address is 802 Church Road, Elkins Park 17, Pa.

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Training in Submarine Medicine

A two week active duty for training course in Submarine Medicine will convene on 6 November 1961 at the U. S. Naval Medical Research Laboratory, U. S. Naval Submarine Base, New London, Conn., for male Naval Reserve Medical Corps and Medical Service Corps officers on inactive duty. Quotas for this course have been assigned to the First, Third, Ninth, and Eleventh Naval Districts.

The course is on-the-job training presenting an up-to-date review of problems relating to submarine medicine, including recent developments in submarine medicine research.

Interested eligible officers should submit applications for this training to their cognizant commandants. Secret clearance is required.

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DENTAL SECTION

Thromboplastic Activity of Human Saliva

Hristo Chris Doku School of Dental Medicine, Tufts University, Boston, Mass. J D Res 39:1210-1221, November - December 1960; Dental Abstracts, August, 1961.

This study was undertaken to determine the effect of saliva in hastening blood coagulation, and to establish the nature of accelerator factors present in human saliva.

In the determination of the clotting time of whole blood, blood samples from 80 healthy subjects were mixed with whole mixed saliva in different proportions. The ratio of blood to whole mixed saliva used was 4:1, 2:1, and 1:1. Also, the comparative effect of whole mixed, submaxillary, and sublingual salivas on blood clotting time was studied on 40 healthy subjects using four

parts blood and one part saliva. For controls, physiologic saline solution was substituted for saliva.

The effect of saliva on decreasing blood clotting time is dramatic. The ratio of saliva to blood was not critical in decreasing the clotting time. One-stage prothrombin, partial thromboplastin, and thromboplastin generation tests were made. It was found that mixed saliva and the pure secretions of parotid, submaxillary and sublingual glands all have thromboplastic activity similar to that found in tissue thromboplastin.

The thromboplastic factors found to exist in saliva include antihemophilic (VIII), Christmas (IX), Stuart (X), P. T. A. (plasma thromboplastin antecedent), Hageman, and a plateletlike activity. Saliva also appears to contain a lipid protein. The inability of salivary fluids to replace adsorbed plasma in the thromboplastin generation test indicates that factor V (labile) is missing in saliva.

These results may have considerable clinical significance. Demonstrations of the presence of the different plasma thromboplastic factors in the saliva of normal persons may aid in developing diagnostic tests for patients with blood dyscrasias. The studies also should contribute substantially to an understanding of the conditions influencing the clotting of blood in the oral cavity.

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Aphthous Stomatitis and Organic Acids

Louis Tuft, Leonard S. Girsh, and L. N. Ettelson, 1530 Locust Street, Philadelphia 2, Pa. JAMA 175:924, 11 March 1961; Dental Abstracts, September 1961.

In studies reported in 1956 and 1958, the authors showed the apparent etiologic relation between the presence of organic acids (especially citric and acetic acids) and the formation of aphthous stomatitis. Canker sores in affected patients could be reproduced by the local application of acetic and citric acids to the buccal mucosa. In patients with canker sores, the elimination of foods containing citric acid (chocolates, citrus fruits, and so forth) from the diets of those with positive mucosal tests to citric acid, and of foods containing acetic acid (vinegar, pickled foods, salads, and so forth) from the diets of those with positive tests to acetic acid, was followed by complete relief or reduction in the number, frequency and severity of the canker sores. On the other hand, ingestion of foods containing these acids caused recurrence of the canker sores.

There exists a definite causal relation, probably on an allergic basis, between these organic acids and canker sores. Foods containing citric and acetic acids should be eliminated from the diets of all patients with canker sores even if mucosal tests with these acids are not performed or yield negative results.

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Personnel and Professional Notes

Oral Pathology Lantern Slides. Due to many requests for lantern slide teaching sets, additional sets on Dental and Oral Pathology have been prepared by the Armed Forces Institute of Pathology for loan to naval personnel and are now ready for distribution.

The 2" x 2" slides, presenting clinical, gross, microscopic, and x-ray material, include: (1) Anomalies, Odontogenic Cysts and Tumors - 100 slides in color; (2) Benign and Malignant Oral Tumors - 100 slides in color; (3) Lesions of the Jaw Bone - 100 x-ray slides and 50 microscopic slides; (4) Gingival and Periodontal Lesions - 64 slides in color; (5) Mouth Diseases - 95 slides in color; (6) Oral Manifestations of Systemic Diseases - 95 slides in color. A complete list and order blank may be obtained upon request to: Director, Armed Forces Institute of Pathology, Washington 25, D. C., Attention: Medical Illustration Service.

The "Quals" Manual. Is a Dental Technician Second Class required to have a working knowledge of the Navy Manpower Information System? Do the duties of a Dental Technician Third Class include servicing Enlisted Service Records? The answers to these and other questions you might have regarding the areas in which a Dental Technician might be tested in service-wide competitive examinations for advancement in rating and the primary reference for Item Writers at the Examining Center is the Manual of Qualifications for Advancement in Rating-NAVPERS 18068 (latest change No. 17 dated March 1961).

Dental Technicians should be referred to this manual before studying for advancement exams. Probably much time is wasted studying material which is not considered for inclusion when the examinations are prepared. Conversely much important material may be overlooked. The Preface to the Manual of Qualifications for Advancement in Rating provides the key for using the manual. For this reason, and in order that they may fully understand the appropriate sections of the manual, the Preface should be read thoroughly.

The Military Requirements section, which is applicable to all rates and ratings, lists those items of general military nature by pay grade. These items are of two types - practical and knowledge factors. Practical factors are those which they must actually perform or demonstrate before they can be recommended for advancement. Knowledge essential to performance of the practical factors, as well as those essential to the required knowledge factors, will be subject to examination for advancement.

The section of the manual entitled Dental - Group XI should receive the greatest attention. Like Military Requirements, Professional Requirements are divided into knowledge factors and practical factors by pay grade. In addition, so that specialties may be properly recognized, certain items apply only to those personnel holding prosthetic or repair NEC's.

The qualifications for advancement in rating are under constant review and revision. As new techniques are developed in dentistry and new concepts of administration and supply support undertaken, the Dental Technician

must keep pace. These innovations are reflected in periodic changes in the "Quals" Manual; so, it is important that you check this Manual carefully. What may have been a requirement for last year's examination could have been replaced by a newer qualification. These changes delete obsolete qualifications so the technician can keep pace with our modern Navy.

Naval Dental Corps Continuous Education Program. A postgraduate course in Oral Pathology will be conducted 11-15 December 1961, at the U. S. Naval Dental School, NNMC, Bethesda, Md. This course is designed to increase the knowledge of the dental officer in the fields of oral pathology and oral diagnosis. Disturbances in development, diseases of the oral mucosa and jaws, the oral manifestations of certain systemic diseases and benign and malignant oral neoplasms are discussed in detail, and their clinical and microscopic characteristics illustrated with slides. Lectures are correlated with case presentations, microscopic seminars, and round table discussions.

CAPT H. H. Schofield DC USN will be the instructor. Quotas for the course have been assigned to the following naval districts and commands: COMONE, COMTHREE, COMFOUR, COMFIVE, COMSIX, COMNINE, PRNC, SRNC, and CNATRA. Applications should be received in the Bureau as early as possible and preferably not less than 4 weeks prior to commencement of the course. The Bureau Professional Advisory Board will make recommendations on all requests and upon approval by the Surgeon General, applicants will be notified as to the final action. Those approved will be nominated for TAD or authorization orders, as appropriate. Accounting data will be forwarded to individual officers nominated for TAD orders.

DT Reenlistment Rate. The Bureau of Naval Personnel reported that for the 12 month period ending 30 June 1961 the dental technician reenlistment rate increased 42.5% over a like period ending 30 June 1960. In June 1960 the reenlistment rate was 35.5% and in June 1961 it was 50.6%.

This increase reflects the dynamic efforts of all individuals concerned with the reenlistment of dental technicians.

CAPT Hansen Presents Lecture. CAPT Louis S. Hansen DC USN, Chief, Dental and Oral Pathology Division, Armed Forces Institute of Pathology, presented a lecture, Development and Diagnosis of Cysts of the Jaws, on 7 September 1961 at the Connemaugh Valley Memorial Hospital, Johnstown, Pa.

CAPT Hansen also lectured to members of the Alexandria, Virginia, Dental Society, 25 September 1961 on the X-ray Interpretation of Oral Lesions.

R. B. Memminger, Esq., Addresses Dental Reserve Meeting. Robert Brodie Memminger, Esq., Bureau of Public Affairs, Department of State, Washington, D. C., recently addressed the officers and guests of the U. S. Naval Reserve Dental Company 8-5, Dallas, Tex.

Mr. Memminger's subject was The U. S. and the International Picture. Mr. Memminger has served as Consul of the Embassy at Rome and Supervisory

Consul General for Italy, Officer in Charge of Central America and Panama Affairs, and Advisor on Baghdad Pact Affairs.

Dr. Gibilisco Lectures at NDS. Dr. Joseph A. Gibilisco, Consultant, Section of Dentistry and Oral Surgery, Mayo Clinic, Rochester, Minn., lectured on Neurophysiology of the Trigeminal Nerve to staff, resident, and postgraduate dental officers, and civilian and military guests, at the U. S. Naval Dental School, NNMC, Bethesda, Md., on 15 September 1961.

Dr. Gibilisco has been trained primarily in operative and restorative dentistry, but has had research experience in the problems of facial and oral neuromuscular anatomy and physiology with emphasis on the function of the trigeminal nerve and dental pain mechanisms.

Currently Dr. Gibilisco is directing studies concerned with neurophysiologic phenomena in experimental animals and also studies based on the analysis of clinical data.

Field Medical Service Course for Dental Officers. The Surgeon General has recently approved a 10-day indoctrination course for Dental officers at the Field Medical Service School, Camp Lejeune, N. C. The course is conducted for those Dental officers who are attached to the Fleet Marine Force, Camp Lejeune, N. C., and on an additional duty basis at no expense to the government. The program will consist of lectures, demonstrations, and practical field exercises, concentrating on the role of Dental officers whose primary assignments are with the Fleet Marine Force. Among the subjects are:

Organization of the FMF and Dental Companies
Care and Use of Individual Field Equipment
Practical Application of Combat Evacuation with Mass Casualty Care and Handling
Use of Field Dental Equipment

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YOUTH

Youth is not a time of life. It is a state of mind. It is not a matter of ripe cheeks, red lips, and supple knees; it is a temper of the will—a quality of the imagination—a vigor of the emotions. Nobody grows old by merely living a number of years—people grow old only by deserting their ideals. Years wrinkle the skin, but to give up enthusiasm wrinkles the soul. Worry, doubt, self-distrust, fear, and despair—these are the long, long years that bow the heart and turn the greening spirit back to dust. Whether 60 or 16, there is in every human being's heart the lure of wonder, the undaunted challenge of events, the unfailing child-like appetite for what next, and the joy of the game of living. We are as young as our self-confidence, as old as our fear, as young as our desire, as old as our despair. (Anonymous, quoted by Gerontological Research Foundation, April, 1960. JADA 63:217, 2 August 1961.)

AVIATION MEDICINE DIVISION

Some Observations on the Effects of Liquid Oxygen Contaminants

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Shortly after liquid oxygen came into use as a source of breathing gas for aviation there were occasional complaints of off odors. These were at times reported to lead to disorientation, nausea, vomiting, etc. These complaints resulted in the initiation of a series of analyses of liquid oxygen. As a result of these studies we now have a good idea as to the exact composition of the contaminants which are ordinarily found in liquid oxygen. The first analyses were made at the Materials Testing Laboratory at NAS, Alameda, California. Following this, contracts were let to Stanford University and the University of California. The analyses have been made with infrared spectrophotometry and mass spectrophotometry. Both of these means of analyses will indicate the presence of any contaminant whether or not its existence was known before the analysis was begun. The contaminants which have been identified, therefore, are all of those which exist in liquid oxygen in any but trace amounts. The contaminants usually found are nitrous oxide, carbon dioxide, water vapor, methane, ethane, ethylene, and acetylene. All of these contaminants are found in rather small amounts. Methane is by all odds the most concentrated of the several contaminants ordinarily found, and a shipment of liquid oxygen is rejected by the Navy if methane exceeds 25 parts per million. This indicates, then, the very small concentration of the contaminants as they are ordinarily found in liquid oxygen.

Following these early studies, personnel at NAS, Alameda, were interested in ascertaining which contaminant or combination of contaminants was responsible for the off odors that occur in liquid oxygen. They, therefore, did a very reasonable thing; they collected air samples from places which had odors. They went to city dumps, paper mills, and tanneries. Each time they analyzed an air sample from one of these sites they consistently found the same two contaminants present, i. e., carbon dioxide and water vapor.

Thus, from the early analytical experiments it seemed to some that carbon dioxide and water were the contaminants which were giving rise to odors in liquid oxygen. It could be pointed out that the carbon dioxide and water vapor levels in liquid oxygen are well below those found in the air which we ordinarily breathe, and if these concentrations make one sick, we should all be sick. However, it could also be stated that the gases we usually breathe

are not evolved from a source which is about -300 F. What may happen to combinations of carbon dioxide and water vapor at these very low temperatures is not known. One cannot deny the possibility for such a cause of odors, but the probability seems remote indeed.

In conjunction with early odor studies, an interesting experiment was performed at NAS, Alameda, which has been repeated since and verified by a number of others. If one sets a metal container filled with liquid oxygen either outside in the open or in a room, a frost forms on the outside of the container. If this frost, at a point where it is very cold, is scraped off the container with a finger and rapidly carried to the nose, a very distinct odor is detected. This is a fleeting odor, and if one obtains frost which is near the top of the container and therefore warmer, the odor is not present. This odor is described by people as having a swimming pool-like quality, a bleach-like effect. If the observer is a chemist, he will tell you that it is a halogen odor. Some have described it as reminiscent of gun powder. That there is an odor present is undeniable. It has been substantiated a number of times. However, it is not the type of odor which is ordinarily detected in contaminated liquid oxygen. We still do not know the origin of the odor from this frost experiment, and it remains an interesting question.

Following these early experiments, it was decided to conduct physiologic experiments on the effects on human volunteers of the contaminants found in liquid oxygen. The Naval School of Aviation Medicine was selected to perform such studies. The resulting physiologic experiments represented a collaborative effort between the School of Aviation Medicine and the personnel of the Materials Testing Laboratory at NAS, Alameda. Samples were prepared at NAS Alameda and were tested for the physiologic effects at Pensacola. Although the most desirable sample would have been liquid oxygen containing a certain known contaminant, such samples are not available for use. Liquid oxygen is continually boiling off and, because of its critical temperature, cannot be contained. In order then to work with a known level of contamination, it was necessary to use as samples aviators' compressed breathing oxygen into which various amounts of known contaminants were placed. These samples were made and then tested on the IR4 infrared spectrophotometer for the level of contamination. In the early experiments it was decided to test for the effects of single contaminants. These contaminants were placed in aviators' compressed breathing-oxygen at several different concentration levels. The maximum concentrations of test mixtures were many times higher than the maximum concentration of the given contaminants which had ever been found in badly contaminated liquid aviators' breathing oxygen. For instance, methane was tested at 1000 parts per million, whereas a shipment is rejected for use in aviation if it exceeds 25 parts per million. Nitrous oxide was tested at 1450 parts per million, whereas the usual level of nitrous oxide is measured only in fractions of a part per million.

The results of the physiologic experiments have been published, so they will be referred to here only in summary form. In the first experiments, laboratory personnel and enlisted men were used as the subjects. The subject

was presented with three sources of breathing gas: (1) all oxygen, (2) all oxygen-contaminant mixture, (3) one contaminant mixture and two pure oxygen sources, or one pure oxygen source and two contaminant mixtures. An analysis of the results from the early experiments indicated that the laboratory personnel and enlisted men could not differentiate between pure oxygen and the oxygen-contaminant mixture. In later experiments jet instructor training pilots, who had had considerable experience breathing both aviators' compressed breathing oxygen and liquid oxygen, were used as subjects. The pilots were chosen for their familiarity with breathing oxygen, motivation, intelligence, and interest in the experiments. The pilots were presented with two sources of breathing gas. One was pure aviators' breathing oxygen and the other was the oxygen-contaminated mixture.

The experiments were designed to present the pilots with pure aviators' breathing oxygen for a given period of time and then either to turn to the oxygen-contaminant mixture or to leave him on the pure aviators' breathing oxygen. This presented the contaminants to the pilots much in the way in which a contaminant might be presented to a pilot in actual use of liquid oxygen, i.e., as a surge of contaminant on a pure background. At the point in time in which the valve was either turned or not turned the aviator was handed a card on which he indicated whether he was continued on the pure aviators' breathing oxygen or was turned to the contaminant-oxygen mixture. During these tests the aviator sat behind a board so that he could not see the cylinders and did not know the direction in which the valves were turned. To further insure that he got no clues concerning the operations of the apparatus, the aviator wore earphones which were connected to a noise generator that was adjusted to an appropriately high level to screen out any possible background noises. As a result of these experiments, it appeared that at least some of our pilot subjects could differentiate between the two sources of breathing gas. When they were able to do this they frequently indicated that the difference in the gases was staleness.

This indicated a possible weakness in the experimental design. The oxygen contaminant mixture lay in the delivery tube for the 45-second period when the aviator was breathing pure aviators' breathing oxygen. During this 45-second period, it could easily pick up odors from the rubber tube in which it was stored. The experimental device was altered, and in the later experiments two sources of aviators' breathing oxygen were used. One was used as the 45-second reference source and the other used as one of the test sources (the other test source being the oxygen contaminant mixture). In these experiments the subject breathed one source of pure aviators' breathing oxygen for 45 seconds, at the end of which time he was handed a card. Simultaneously with handing him the card, he was changed either to the other source of pure aviators' breathing oxygen or to the oxygen-contaminant mixture. The aviator had 15 seconds in which to make a decision as to which of these two choices was made by the operator. The sequences were determined from a list of random numbers. The results of these experiments indicated several things. First, it was immediately clear that two of the ten pilots used as

subjects had outstanding olfactory acuity as compared with the others. It was also clear from the results that several of the pilots (including, of course, those two with superior olfactory acuity) could differentiate the pure oxygen and the oxygen-contaminant mixtures. However, the experimental design required not only that the pilot differentiate, but that he also designate which was the pure oxygen source and which was the oxygen-contaminant mixture. Although the pilots were able to differentiate, they were not able to designate. More frequently than not the designations were reversed; i. e., pure oxygen was referred to as the oxygen-contaminant mixture and defined as having an odor and the oxygen-contaminant mixture was referred to as a pure oxygen. Critical appraisal of the results indicated that very likely the two sources of pure aviators' compressed breathing oxygen actually varied more from each other in terms of odor differences than either one did from the oxygen-contaminant mixture which was being tested. Such a circumstance would yield the results obtained.

To test this hypothesis, another experiment was designed in which the two sources of pure aviators' compressed breathing oxygen were compared. When the two sources were separated by a time interval during which room air was breathed as a reference gas, the two subjects with outstanding olfactory acuity could not differentiate between them. However, when comparisons were made contiguously in time, the two aviators were unfailingly able to make statistically significant differentiations. When these results were obtained, the two cylinders were analyzed to see what contaminants were present which might possibly account for the odor differences. All of the contaminants present were in vanishingly small amounts, measured only in fractions of a part per million, except methane which was present in one cylinder at 9 parts per million concentration and in the other at 16 parts per million. That methane was not the substance producing the odor was unmistakably clear since these two sources of pure aviators' breathing oxygen had been compared with an oxygen-contaminant mixture which contained as much as 1000 parts per million of methane where the oxygen contaminant mixture was designated as pure oxygen and one of the two oxygen sources was designated as the contaminant. When the two cylinders of pure aviators' breathing oxygen were reversed, the designation as to which was the contaminant was also reversed. Apparently, then, the cylinder of aviators' compressed breathing oxygen which was used as the reference gas was by definition pure oxygen. The sample which most closely resembled it was, therefore, by definition pure aviators' breathing oxygen. The other sample which was more different from it was a contaminant-oxygen mixture. Additional experiments on the ability of pilots to differentiate between pairs of cylinders of pure aviators' breathing oxygen were conducted at a later time. But since they do not fit chronologically into the story at this time, the account of these experiments will be delayed until later in this report.

The results of these early experiments indicated several things. First, there was no sickness even though the levels of contamination were many times higher than those which are ever found even in badly contaminated liquid

oxygen. Second, differentiation was possible, but designation was not possible. The ability to differentiate was apparently not associated with any of the known contaminants. It was, therefore, concluded that contaminants which were below the level of resolution of the instruments used must be responsible for the detectable differences between the sources used. It was also noted that some subjects have an olfactory acuity of a much higher order than the average person. More will be said about the role of olfactory acuity. One of the subjects, a jet instructor training pilot with high olfactory acuity, became known by his peers as "the nose." The experiments were conducted in a hangar at the airfield, and all of the pilots in the squadron knew of the nature of the experiments; thus, this one subject with high olfactory acuity became well known for his talents. This is mentioned because this subject figures rather largely in the next story related by the author.

At about the time these experiments were being conducted, "the nose" reported that he had had a bad oxygen experience. His story indicated that he and another instructor were making an instrument hop. The first one to detect an odor in the liquid oxygen did not report it until the other had also perceived it. Both pilots continued to be bothered by the odor for about 20 minutes. Both agreed that they became ill from the presence of the odor and could not have completed the flight; therefore, they aborted the mission and came in.

This initial episode in which "the nose" figured prominently was followed by a rash of complaints of odors in liquid oxygen. Each time there was a complaint, the remaining oxygen in the converters was analyzed for the presence of contaminants and smell tested. At no time was the level of contamination above an acceptable figure. With the possible exception of one episode, an odor was never detected in the offending converters. The episodes soon constituted an "epidemic." When the epidemic was a few weeks old, an airplane with a capable instructor and a student aboard penetrated an assigned floor of 12,000 feet and was 6 minutes in view by the testimony of ground observer before it went in at an angle of approximately 85 degrees. During these 6 minutes there was no communication between the aircraft and the tower, and neither the student nor the instructor ejected.

As far as liquid oxygen was concerned there was immediate incrimination. The finger of suspicion was immediately pointed at liquid oxygen. The Bureau of Naval Weapons called the Naval School of Aviation Medicine and asked for assistance in the accident investigation with regard to physiologic and life support system factors.

The Bureau of Naval Weapons sent to the Pensacola Command experts from a number of fields including psychology, physiology, liquid oxygen manufacture, and liquid oxygen systems. They met with representatives from the military at Pensacola in a 2-day discussion of liquid oxygen contaminants. During this meeting all facets of liquid oxygen supply and handling were explored. The number of places in the handling of liquid oxygen where contaminants could be introduced were mentioned. But it was stressed repeatedly that the type of contamination that could be introduced at these points should certainly not yield toxic levels. Any odors resulting from such accidental

combination should be fleeting in nature. The manufacturing procedure for liquid oxygen and the long history of many thousands of tests of liquid oxygen (which have never yet revealed a toxic level of contamination) were related.

One of the most significant observations was that odors in liquid oxygen should be reported more frequently than they are. As liquid oxygen is stored and boils off, the contaminants are concentrated; thus, it is likely that odors occur frequently but their presence is ignored. Personnel are constantly "bombarded" by odors, most of which are ignored. It is very likely that many odors in liquid oxygen are similarly ignored. Their detection may be increased when the pilot is expecting an odor, is apprehensive of his breathing supply, or when his olfactory mechanism may be particularly sensitive by continued breathing of 100% oxygen or because of drying of the mucous membranes. All of these might alter the function of the olfactory mechanism, making odor detection more likely.

As a result of the 2-day discussions of the panel, liquid oxygen was given a clean bill of health. At the end of the meetings the safety officer from the squadron where the accident occurred said he wished his pilots could have been there to hear the discussions. He felt that problems relative to liquid oxygen contamination and reports of odors would be largely solved if they could benefit from such a discussion.

Shortly after the liquid oxygen panel, the liquid oxygen problem was discussed before the Admiral's Safety Council. Shortly after this, the author was invited to discuss the liquid oxygen contaminant problem with the instructors and students of the squadron where the accident occurred. In his introduction the commanding officer told the instructors and students that, although it was certain that there was no toxic material in the liquid oxygen, odors occasionally occurred; and the relationship between odors and toxicity needed to be clarified. It is gratifying that the results of the discussion in the liquid oxygen panel and Admiral's Safety Council had this effect. Following these lectures on liquid oxygen contamination, there has not been a single report of off odors in liquid oxygen by either the instructors or the students of the author's squadron.

It should be mentioned in conjunction with the bad oxygen complaints at Sherman Field that neither Brookley Air Force Base, through which Sherman Field gets its liquid oxygen, nor any of the outlying navy fields near Pensacola which used liquid oxygen from the storage tank at Sherman, had a single complaint of odors in liquid oxygen. This does not mean that odors were not present. As a matter of fact, during the "epidemic" it was noted that the level of contamination, although always within acceptable limits (with the exception of one shipment which was rejected), was continually rising. It, therefore, is very likely that the occurrence of odors was increasing. It is interesting to note, however, that only those who were looking for odors found odors in the liquid oxygen.

The contaminants which have been identified in liquid oxygen are very likely not responsible for the odors that exist. However, they appear to be correlated with the presence of materials which cause odors, for it has been

a frequent experience that when the level of detectable contamination increases, the probability of complaints of off odors in liquid oxygen also increases.

At this time it might be interesting to digress a little. As compared with some of our other senses, the sense of olfactory acuity is quite remarkable. For instance, humans can smell mercaptan in a concentration of less than one part in 30 million. Vanillin can be detected in even smaller concentrations. Even though such acuities seem quite marked they are small, indeed, as compared with the olfactory acuity of the dog. When the master and his dog go outside after dark, for instance, the world is alive to the dog through his nose. He detects a number of things, such as the female dog in heat down in the next block, which is not apparent at all to his human companion. Even the olfactory acuity of the dog is dwarfed by that of some other members of the animal kingdom. Some enterprising British entomologists have demonstrated the really remarkable acuity of the male silk worm moth. These moths have been transported in trains and released at various distances from trapped female silk worm moths. A surprising percentage of the male moths find their way to a female moth 10 kilometers distant. Now, when you take a female moth and spread her small weight loss responsible for the odor over a circle having a radius of 10 kilometers, it is spread pretty thin. Not only must the male detect the odor of the female, but he must also detect a concentration radiance in order to accurately locate her.

At first examination the acuity of the male silk worm moth seems almost supernatural. One wonders initially if the female silk worm moth could be represented by even a single molecule per cubic centimeter of air. Simple calculations, however, indicate that she could likely be represented by several molecules per cubic centimeter of air. It is interesting to note the number of molecules of substance present at a given concentration. One gram molecular weight of a gas fills 22.4 liters, and a gram molecular weight of any gas has roughly 10^{23} molecules. Therefore, a cubic centimeter of this gas is represented by approximately 10^{18} molecules. If the contaminant is present at a concentration of one part in one billion, that is 10^{9}, this contaminant is represented by one billion molecules per each cubic centimeter of gas. If the female silk worm moth, therefore, were represented by one molecule for each cubic centimeter, she would be represented by one part in one billion billion. It is theoretically possible for the antenna-like olfactory apparatus of the male silk worm moth to detect concentrations of such low order of magnitude.

Not only are there great differences in olfactory acuity among the members of the animal kingdom, but there also appears to be a wide difference in olfactory acuity among members of the human race. Most of us are acquainted with optical illusions, the tricks that the usually reliable eyes can play on us. Not so many, however, are acquainted with the reliability of the olfactory mechanism. Psychologists assure us that the relative frequency of hallucinations and illusions in olfaction are much greater than they are in any of the other senses. Doctor John Paul Nafe, one of the original investigators in some of the facets of olfaction, tells of some interesting experiments that

were conducted during the 1920's. The experiments were designed to test the olfactory threshold for various substances. In control studies, the subjects were placed in a room and pure air was passed through the room. In this test procedure the subjects were asked to indicate when they smelled lilacs. Doctor Nafe says that almost without exception all of the subjects sooner or later smelled lilacs. Illusions and hallucinations, therefore, are apparently very frequent occurrences in olfaction. This should cause one to look with some uncertainty on the impulses and sensations which he gets from this mechanism.

Some experiments relative to the presence of odors in aviators' compressed breathing oxygen were mentioned earlier. These experiments, dealing with so-called cylinder odors are germane to the present discussion. When it appeared that aviators could differentiate between two cylinders of pure aviators' breathing oxygen, it was decided to test to see how many pairs of cylinders could be differentiated by subjects with high olfactory acuity. Pairs of cylinders of compressed breathing oxygen were selected at random from stock at NAS, Pensacola. These cylinders were tested by two subjects with high olfactory acuity. The results of the experiments can be stated very briefly. No two cylinders were found which could not be differentiated by the two subjects who were used. One of these subjects was "the nose" who was mentioned earlier. This subject did not smoke. The other subject was an enlisted man who did smoke. He was not a pilot, but he had outstanding olfactory acuity. Since members of all pairs of cylinders of aviators' breathing oxygen could be differentiated by olfaction, it must, by definition, then be said that every cylinder of aviators' compressed breathing oxygen has an odor. It should be stressed that the factors responsible for the differentiation were never described by the subjects as being undesirable. Nevertheless, as the results of these experiments indicate, it seems certain that one must describe pure aviators' compressed breathing oxygen as having a characteristic odor.

Since at least some of the pairs of cylinders must have been taken from the same manufacturing batch, it was decided to ascertain whether or not the odors might be added to the aviators' compressed breathing oxygen during storage. For this study two cylinders of aviators' compressed breathing oxygen were prepared. One was an ordinary cylinder, the other was a stainless steel cylinder. Both cylinders were filled from the same source. The subjects were unfailingly able to differentiate these two cylinders. As a matter of fact, they indicated that the differentiation was easier here than in the usual pair of cylinders with which they were confronted. It appears certain then that aviators' compressed breathing oxygen picks up odors while in storage, and these odors are, therefore, referred to as cylinder odors.

Since odors are more easily picked up by liquid oxygen and since the odors are concentrated by the evaporation or boiling off of the liquid oxygen, it is likely that all liquid oxygen must have a characteristic odor if one with a high olfactory acuity is looking for it.

We could not leave the subject of olfactory acuity and odors without saying something about the physiology of our olfactory mechanism. One of

the most singular features is its very rapid adaptation. By adaptation we mean the failure of a constant stimulus to continue to produce a sensation. Examples of sensory adaptation are numerous. After a watch is put on the wrist in the morning, a hat on the head, or glasses over the ears, the presence of these mechanical things is soon forgotten. As a matter of fact, apparently of all the many different types of receptors in the body, only those for pain do not adapt. Adaptation is particularly rapid in olfaction. We are all acquainted with this adaptation. One sometimes drives through a town where there is an offensive odor produced by some industry. When you first enter the town, the continued stay in this atmosphere seems impossible, and yet one notices people living an apparently normal life. After you remain awhile, the presence of the odor is not so discernible. The olfactory mechanism has adapted to the odor. Faint odors and, as a matter of fact, even more concentrated odors, should not persist. When a pilot indicates that he has detected a faint odor and that this odor has persisted for a number of minutes, one strongly suspects a strong element of hallucination. Our psychologist friends assure us that the hallucinatory odor will be just as real as will an actual odor and that such hallucinatory odors are frequently encountered. So much then for the physiology of olfaction.

We should also consider odors as they occur in liquid oxygen. First of all, and perhaps most important, the substances producing the odors are not evenly distributed in the liquid oxygen. Therefore, the odors will not occur in a homogeneous fashion. This is because the contaminants which cause the odors, although we do not know their exact nature, are concentrated by boiling off the liquid oxygen. A concentration of contaminants when withdrawn from the converter bottle and warmed in the heat exchanger may produce a momentary surge of odor. What this means, of course, is that liquid oxygen can be smell-tested on the ground and not have an odor, and yet an odor may occur during flight. What it also means is that the odor which occurs during flight should be fleeting in nature and should not persist for more than a few breaths at the most. It should be stressed that the substances which are responsible for the odors apparently have not been identified. As a matter of fact, they may never be. The nose is a much better instrument than even the best instruments which we can bring to bear upon this problem. For instance, the sophisticated infrared spectrophotometers can detect the presence of contaminants at a fraction of a part per million. The nose can detect the presence of many substances in fractions of a part per billion. This is a thousand-fold magnitude difference between the sensitivity of the nose and even the best analytical instruments. If we could look deep into liquid oxygen and note all of the contaminants which are present in more than a fraction of a part per billion, we would likely have a very long list. Trying to sort out from this the contaminants which are responsible for causing the odors would likely be a very difficult task. However, until different types of instruments are developed we shall not have even the opportunity of looking at all of the contaminants which are present which might be detected by the very acute olfactory mechanism.

One notes a considerable confusion concerning the relationship between contaminant levels and toxicity. First of all, the word contaminant is perhaps a poor choice. These substances found in liquid oxygen could more accurately be referred to as minor constituents. They are really not contaminants in the sense that they in any way jeopardize the purpose for which the liquid oxygen is intended. There is similarly considerable confusion between specifications for maximum allowable contamination levels for delivery and toxicity levels. This confusion can be largely avoided if one spells out what the specifications for liquid oxygen purity really present. In essence, these specifications represent the purest product which industry can, with reasonable care, deliver. As an example, the first specifications which were given indicated that only 5 parts per million of methane were acceptable. It was rapidly learned, however, that industry could not meet this specification and so the maximum allowable level for methane was raised to 25 parts per million. What these specifications represent, then, is the purest product that the industry can produce with reasonable quality control. These specifications bear no relationship to toxicity.

As a matter of fact, the substances which have been identified in liquid oxygen are not toxic by the usual definition of a toxic material. Methane, for instance, becomes harmful only when it displaces enough gases to produce hypoxia. This probably will never be a physiologic problem in aviation, because a long time before methane has displaced enough oxygen to produce hypoxia, it will have reached an explosive level and the aircraft and pilot may cease to exist. The other substances which are found in liquid oxygen are almost as nontoxic as is methane. Nitrous oxide, for instance, is "laughing gas" or the gas which some dentists use. This gas is not even a good anesthetic until it approaches nearly 80% concentration. Acetylene, a gas used for welding, also has mild anaesthetic properties in very high concentrations. Most of the other contaminants found in liquid oxygen are familiar to us, water vapor, carbon dioxide, etc., and they are certainly not toxic at anything near the concentration levels found in even badly contaminated liquid oxygen.

To the author's knowledge not a single case of even accidental contamination of liquid oxygen has reached a toxic level of contamination. There have been several instances of gross accidental contamination. These have been quickly detected and the cause of contamination found. Even in these cases the level of contamination probably did not reach a toxic proportion in any of the converters.

One might ask, then, why the episodes of bad oxygen complaints? The possible genesis of an episode might be as follows. Fleeting odors are detected. As a matter of fact, as stressed earlier, odors ought to be detected more often than they are. The fleeting odor very likely persists psychologically. This does not mean that it is any less real to the aviator. If the presence of an odor is associated in the mind with a toxic level of contamination, it is easy to see how the odor can be psychologically exaggerated to toxic proportions and produce real physical symptoms. It is a frequent observation that

whenever one becomes apprehensive of the breathing gas, hyperventilation follows, and serious symptoms of syncope and disorientation occur.

It is strongly felt that if the aviators understand something of the nature of the physiology of olfaction and understand clearly the relationships between contamination levels and toxicity, they will not react adversely to the occurrence of expected odors in liquid oxygen. A series of education or indoctrination lectures has been given at a few Regional Safety Council Meetings. The acceptance of these talks has been gratifying, and it is felt that continued education in this field represents the surest, and certainly the most economical means of coping with the problems of contamination and odors in liquid oxygen.

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